S

CONFIDENTIAL

P-227

[redacted] 25X1

EXECUTIVE OFFICE

[redacted] 25X1

Attention: [redacted] 25X1

Re: Our Proposal No. 1129-414

Dear Sir:

In conjunction with the line analyzer developed by your agency, a number of possible improvements have been suggested. These ideas have been aimed at making the instrument more usable with less demands on the operator while retaining the same basic functions as the original model.

The first major advance will be to make the line analyzer independent of the power source. This obviates the difficulties of running extremely long lines to power the instrument after the lines under investigation have been "killed". The obvious solution is to make a battery powered instrument. In order to obtain reasonable life with batteries, both the VTVM and the oscillator have to be transistorized. This laboratory's experience indicates that the VTVM can be developed to have an accuracy of ± 5%, a frequency range of 10 cps to 500 kcps and a dynamic voltage range of 3 mv to 300v.

Preliminary circuit design (see attached figure) yields the results that the above mentioned specifications can be met with the use of 4 surface barrier type transistors (2N128). A single 9.4 volt mercury cell will suffice to operate the unit for a period of 125 hours of continuous usage.

[redacted]

[redacted] 25X1

CONFIDENTIAL

25X1

The input circuit (consisting of a fixed voltage divider and a ladder type attenuator) is capacitive compensated which is necessitated by the large bandwidth involved.

At present, the input circuit impedance is approximately 1000 ohms which should be adequate for use with the types of circuits presently contemplated. The only difficulty that may be encountered would be in the "blast' test in which a dc or ac voltage with maximum amplitude of three hundred volts is applied to a line. At full scale, the power dissipated in the VTVM would be prohibitive. A simple way out of this difficulty is merely to pad the input to the meter with a high resistance and use the meter directly. The meter that had been considered is a 200 ua, 100 mv meter. The series resistance that would make the meter read full scale for maximum voltage would be 1.5 megohms. This would represent a maximum drain of 60 milliwatts.

This procedure is desirable since it is a requirement to keep the number of meters on the analyzer to a minimum.

Another approach that would accomplish the same results would be to build the VTVM with a high input impedance. This might also further extend the usefullness of the measuring equipment. At present, this high input impedance offers no advantages since all the circuits to be tested are 600 ohms or less. However, it is conceivable in the future that new extensions of usage might call for high impedance inputs. While in general it is difficult to achieve extremely high input impedances with transistor circuitry, it has been brought to this laboratory's attention by your agency that an instrument is on the commercial market that maintains a ten megohm input impedance over all ranges. This instrument will be purchased and analyzed. If the technique of achieving high input impedances is complex or costly, the decision will be left to the cognizant liaison engineer in your organization to render a decision as to whether or not to incorporate the new circuitry into the transistorized line analyzer. The laboratory design shown in the accompanying diagram can be accomodated easily to a high input impedance by the straightforward technique of prefacing the transistors by a subminiature tube. This somewhat academic advantage is attended by a subsequent large increase in battery drain.

25X1

The oscillator will be the major source of development, but is straightforward in execution with no fundamental research required. This laboratory has designed matching transformers to frequencies of 10 mcps. The output will be 3 volts rms $\pm$ 10% at 1000 cps and the variations in output will be less than 3 db over the range of 10 cps-500 kcps. The output impedance will be 600 ohms $\pm$ 1 db from 10 cps to 500 kcps and the maximum current drain (under matched conditions) will be 4 ma. The present thinking is to avoid the use of a matching transformer by working directly from the transistor output stage. In the event that this does not prove practical, the use of output transformers will be utilized. Two transformers will definitely meet the requirements (the switching will be tied to the range switch on the oscillator so that no external manipulation will be required). However, considering the small power output, it may be possible to extend the range of a single transformer to meet the above specifications.

The attached circuit diagram represents the "breadboard" of the highest decade range needed. The range encompassed by this model ranges from approximately 100 kcps to over one megacycle. (It was felt that the upper frequency limit and the lower limit represent the difficult portions.) This bandwidth of 900 kcps can be used directly with a fixed oscillator to give a B.F.O. covering the desired band. However, this precluded the use of a range switch and in consequence, it is felt that a single band sweep of the desired range would lose too much of the "fine" detail and be troublesome to set and reset the frequency accurately. In consequence, this technique has been eliminated on an a priori basis. The stability, distortion, low level are all excellent on the decade tested. The output level is low and there will be a transistor amplifier following to boost the output to 3 volts rms. While considerable efforts will be expended to reduce the distortion, it is safe to say that distortion will be less than 10% over the entire frequency band.

For the "blast" test it is required to provide 0-230 volts 55-60 cycles with a power capability of 4 watts and a DC voltage of 0-300 volts with the same power output. While the use of a transistor switching circuit will be considered, the most straightforward approach will be the use of a small vibrator with some smoothing on the output. Inasmuch as the presence of harmonics may actually be desirable extreme smoothing will not be attempted. The "blast"

25X1

test will necessitate the usage of relatively large amounts of power and in consequence, the power supply will be dependent on the type of usage this function is required to perform. The present thinking is to provide enough batteries integral with the unit to provide for an exceptional days usage. Thus the batteries can be changed each day without interrupting the work in progress. However, provision will be made to permit either an auxiliary battery supply or AC 110/220V operated supply to be plugged in.

Inasmuch as even the four watt output will require a circuit input of several amperes, a separate battery supply will be utilized. Two "D" cells have an energy capacity of approximately 10 watt-hours. Inasmuch as the "blast" test will take a short time in which any drain is being observed, it is anticipated that a "D" cell should last two months (assume 30 seconds of full drain, twenty times a day).

Two meters will be provided. One voltmeter will have a 0-300 scale. A four position switch will enable this meter to be used with the voltmeter to cover its four decades from 3 millivolts to 3 volts full scale. The function switch will convert this to direct reading of 0-300 volts AC or DC for use with the "blast" test. The second meter will be a combined AC-DC milliameter (set by the function switch) with a range of 0-30 ma.

The two meters will enable the simultaneous reading of the applied voltage and resultant current drain.

An audio preamplifier will be incorporated with a continuously variable gain. The maximum gain will be in excess of 40 db at 1500 cps. The output will be designed to feed crystal earphones such as the Brush BA200.

An estimate of the size of the unit leads to the conclusion that the volume will be about one-quarter of the present unit (under 200 cubic inches). The unit will operate satisfactorily at temperatures from 0-120°F and willwithstand vibrations of 1/64" amplitude to 55 cps on three mutually perpendicular axes.

Extensive testing will be performed on the unit both electrically and mechanically with the layout and design such that the unit can be placed into production immediately without redesign. Rigorous selection will be made of components with commercial grade components being utilized only where there is no equivalent mil component.

25X1

A prototype will be delivered at the end of six (6) months and three additional units supplied one (1) month after prototype acceptance.

The cost breakdown to accomplish the foregoing is as follows:

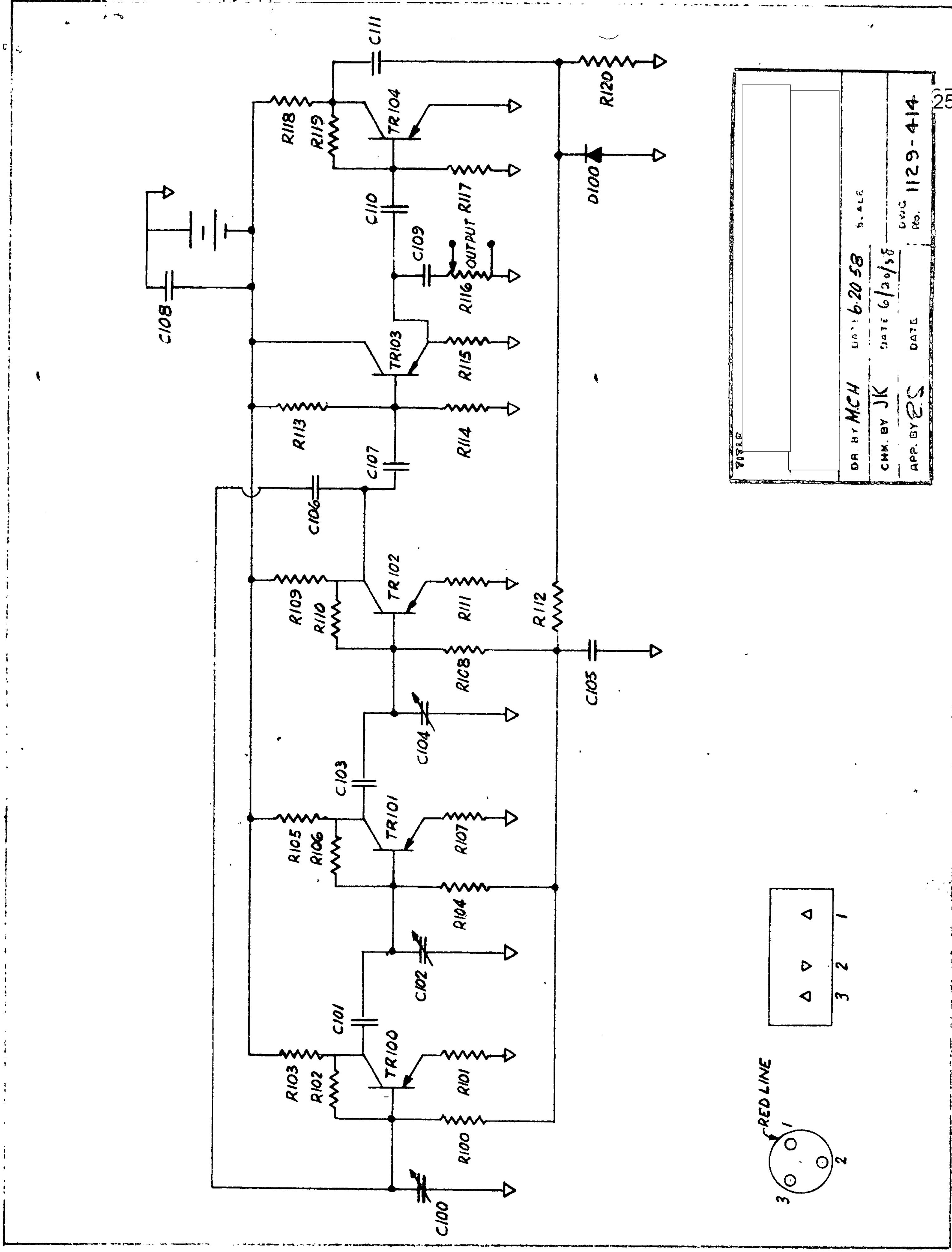
Labor:				
1	Sr. Engineer	$5.10/hr.	1040 hrs.	$ 5,304.00
1	Engineer	4.00/hr.	1000 hrs.	4,000.00
2	Technicians	2.75/hr.	2089 hrs.	5,744.75
1	Draftsman	2.75/hr.	500 hrs.	1,375.00
1	Clerk-Typist	2.10/hr.	300 hrs.	630.00
				$17,053.75
Overhead at 46.53:				7,935.11
				$24,988.86
Materials:				6,500.00
Testing:				500.00
Out of Pocket:				500.00
				$32,488.86
Fee at 7%:				2,274.22
		Total:		$34,763.08

Should you desire us to accomplish the work covered by this proposal, we would greatly appreciate receiving a Task Order under our contract.

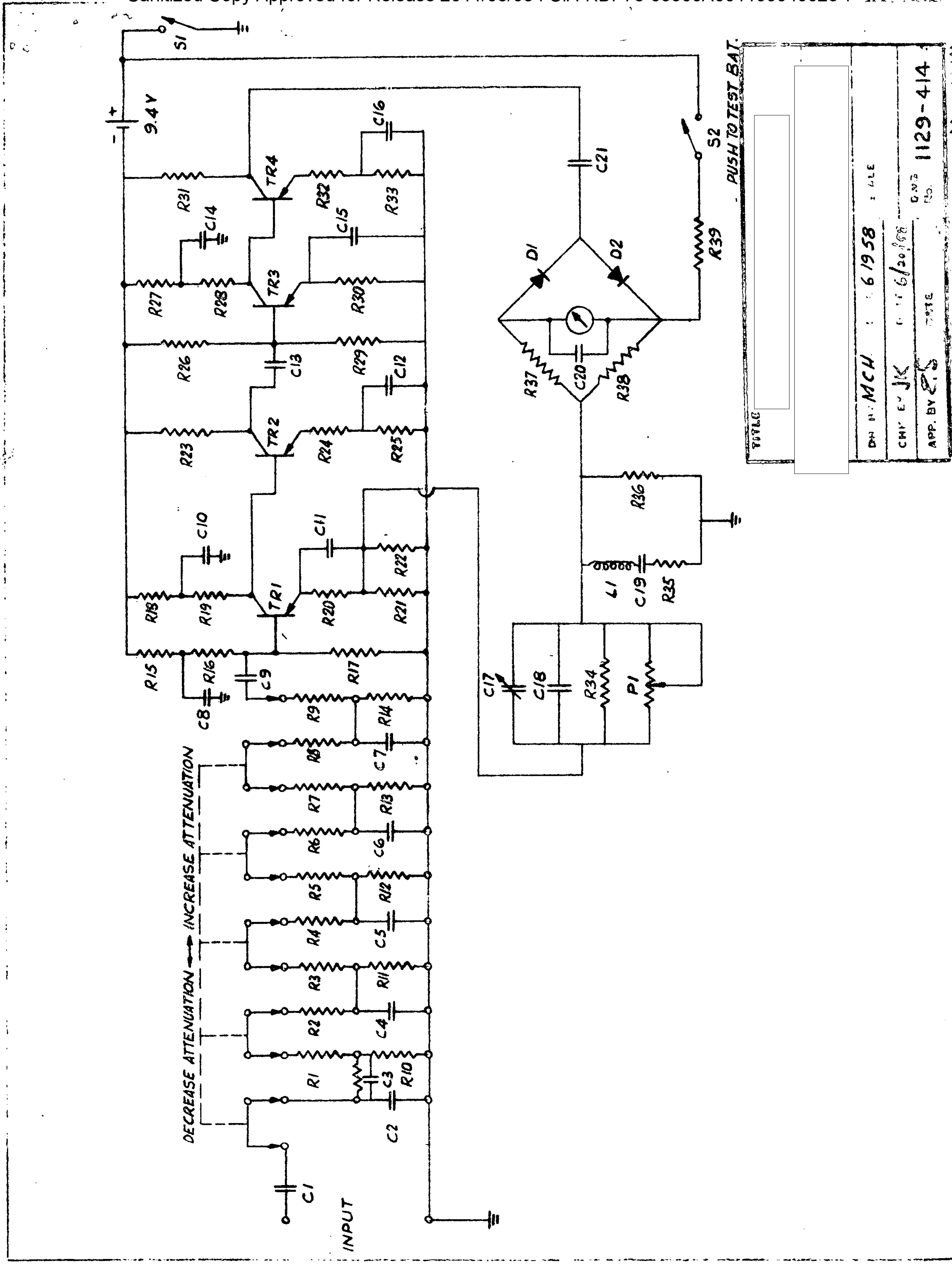
Very truly yours,

25X1

25X1


C111
R120
R118
R119
TR104
D100
R117
C110
OUTPUT
C109
R116
C108
TR103
R115
R113
R114
C107
C106
TR102
R109
R110
R111
R112
R108
C105
C104
C103
TR101
R105
R106
R107
R104
C102
C101
TR100
R103
R102
R101
R100
C100
1
2
3
RED LINE
DR. BY M.C.H
DATE 6-20-58
CHK. BY JK
DATE 6/20/58
APP. BY
DATE
SCALE
DWG No. 1129-414

25X1


PUSH TO TEST BAT.
1129-414
9.4V
S1
S2
DECREASE ATTENUATION ⟷ INCREASE ATTENUATION
INPUT
TR1
TR2
TR3
TR4
D1
D2
L1
P1
MCH
JK
TITLE
APP. BY

25X1

25X1

25X1

July 1, 1958

Addendum to Proposal No. 1129-414

1. When the oscillator is used to locate the position of a microphone when the microphone lead is available, the following shall be the specifications for the sound level to be generated:

A BA110 crystal microphone placed one foot from a G.R. Sound Level Meter, type 1551A with "Cflat" weighting should produce a reading in excess of 64 db. This test shall be performed with the background ambient noise less than 50 db.

2. An investigation shall be made into the need for and practicality of obtaining a low output impedance of the oscillator when used in measuring the response of low impedance circuits. Currently with this evaluation, an effort will be made to improve the sensitivity of the V.M. to one millivolt or better.

3. Batteries will be standard commercially available types.

4. While the basic functions are as stated in the body of the proposal, it is understood that various changes will be effected on the limits of different parameters as more information is available to your agency. However, further changes are to be avoided after the unit is ready for packaging which it is anticipated will be by the end of the fourth month after work has commenced.

5. Stress will be laid on reliability and ruggedization of the entire functioning unit. This will incorporate both component selection and testing from the reliability standpoint and also mechanical layout to insure reliability under various environmental conditions. A Bench Handling Test will be performed as follows:
a) Tilt up the assembly through an angle of 30° using an edge of the assembly as a pivot and permit the assembly to drop back freely to the horizontal. Repeat using other practical edges of the same horizontal fall as pivots for a total of 4 drops. Repeat a) with the assembly resting on other faces until it has been dropped a total of 4 times on each practical face. Upon completion of the above test, the equipment will be turned on and shall operate successfully.